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TITLE: Organic semiconductor recognition complex and system

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INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kiel; Johnathan L.	Universal City	TX	N/A	N/A
Bruno; John G.	San Antonio	TX	N/A	N/A
Parker; Jill E.	Floresville	TX	N/A	N/A
Alls; John L.	San Antonio	TX	N/A	N/A
Batishko; Charles R.	Richland	WA	N/A	N/A
Holwitt; Eric A.	San Antonio	TX	N/A	N/A

ASSIGNEE INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Conceptual Mind Works, Inc.	San Antonio	TX	N/A	N/A	02

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PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATIONS This application claims the benefit under 35 U.S.C. .sctn.119(e) of provisional Patent Application Serial Nos. 60/142,301, filed Jul. 2, 1999, and 60/199,620, filed Apr. 25, 2000. The invention described herein was made with Government support under contracts F41622-96-D-008 and F41824-00-D-700 awarded by the Department of the Air Force and Department of Energy contract number DE-AC06-76RL01830. The Federal Government has a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the subject invention.

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REF-CITED:

U.S. PATENT DOCUMENTS					
PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL		
3970518	July 1976	Glaever et al.	435/239	N/A	N/A
4230685	October 1980	Senyei et al.	436/526	N/A	N/A
4677055	June 1987	Dodin et al.	435/7.32	N/A	N/A
4695393	September 1987	Chagnon et al.	252/62.54	N/A	N/A
4777019	October 1988	Dandekar	422/68	N/A	N/A
5003050	March 1991	Kiel et al.	534/573	N/A	N/A
5156971	October 1992	Kiel et al.	435/252.31	N/A	N/A
5270163	December 1993	Gold et al.	435/436	N/A	N/A
5376963	December 1994	Zortea	348/222	N/A	N/A
5424545	June 1995	Block et al.	250/343	N/A	N/A
5446543	August 1995	Nakagawa et al.	356/405	N/A	N/A
5464768	November 1995	Kiel et al.	435/240.2	N/A	N/A
5475096	December 1995	Gold et al.	536/23.1	N/A	N/A
5567588	October 1996	Gold et al.	435/436	N/A	N/A
5578832	November 1996	Trulson et al.	250/458.1	N/A	N/A
5580737	December 1996	Polisky et al.	435/436	N/A	N/A
5582981	December 1996	Toole et al.	435/436	N/A	N/A
5595877	January 1997	Gold et al.	435/436	N/A	N/A
5632957	May 1997	Heller et al.	422/68.1	N/A	N/A
5637459	June 1997	Burke et al.	435/436	N/A	N/A
5641629	June 1997	Pitner et al.	435/436	N/A	N/A
5650275	July 1997	Pitner et al.	435/436	N/A	N/A
5658673	August 1997	Holwitt et al.	428/423.1	N/A	N/A
5670637	September 1997	Gold et al.	536/22.1	N/A	N/A
5683867	November 1997	Biesecker et	435/436	N/A	N/A
5696249	December 1997	al.	536/23.1	N/A	N/A
5707796	January 1998	Gold et al.	435/436	N/A	N/A
5712375	January 1998	Gold et al.	530/412	N/A	N/A
5763177	June 1998	Jensen et al.	435/436	N/A	N/A
5789157	August 1998	Gold et al.	435/436	N/A	N/A
5817785	October 1998	Jensen et al.	536/23.1	N/A	N/A
5818044	October 1998	Gold et al.	250/339.06	N/A	N/A
5837832	November 1998	Sodickson et	536/22.1	N/A	N/A
5837860	November 1998	al.	536/25.3	N/A	N/A
5843653	December 1998	Chee et al.	435/436	N/A	N/A
5853984	December 1998	Anderson et al.	435/436	N/A	N/A
5856108	January 1999	Gold et al.	435/7.32	N/A	N/A
5861242	January 1999	Davis et al.	435/5	N/A	N/A
5861254	January 1999	Kiel et al.	435/436	N/A	N/A
5864026	January 1999	Chee et al.	536/23.1	N/A	N/A
5867265	February 1999	Schneider et	356/328	N/A	N/A

5874218	February 1999	al.	435/436	N/A	N/A
5902728	May 1999	Jensen et al.	435/437	N/A	N/A
5958691	September 1999	Thomas	435/436	N/A	N/A
5972721	October 1999	Drolet et al.	435/526	N/A	N/A
5989823	November 1999	Parker et al.	435/436	N/A	N/A
5990479	November 1999	Pieken et al.	250/307	N/A	N/A
6001577	December 1999	Bruno et al.	435/436	N/A	N/A
6013520	January 2000	Jayasena et al.	435/354	N/A	N/A
6028311	February 2000	Weiss et al.	250/343	N/A	N/A
6030776	February 2000	Gold et al.	435/436	N/A	N/A
6043909	March 2000	Parker et al.	358/504	N/A	N/A
6072464	June 2000	Sodickson et al.	345/154	N/A	N/A
		Eaton et al.			
		Holub			
		Ozeki			

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
WO91/19813	December 1991	WO	
WO96/40991	June 1996	WO	
WO99/31275	June 1999	WO	

OTHER PUBLICATIONS

Bruno & Yu, "Immunomagnetic-electrochemiluminescent detection of *Bacillus anthracis* spores in soil matrices", *Appl. Environ. Microbio.*, 62:3474-76, 1996.

Bruno et al., "Preliminary electrochemiluminescence studies of metal ion-bacterial diazolumelanin (DALM) interactions", *J. Biolumin. Chemilum.*, 13:117-123, 1998.

Bruno, John G., "In vitro selection of DNA to chloroaromatics using magnetic microbead-based affinity separation and fluorescence detection", *Biochim. Biophys. Res. Comm.*, 234:117-120, 1997.

Bruno, John G., "A colorimetric inhibition study of single-stranded DNA decamer sequence interactions with dinitrotoluene", *Biochem. and Biophys. Res. Comm.*, 236:344-346, 1997.

Bruno, John G., "Broad applications of electrochemiluminescence technology to the detection and quantitation of microbiological, biochemical and chemical analytes", *Recent Res. Devel. in Microbiology*, 1:25-46, 1997.

Famulok and Mayer, "Aptamers as Tools in Molecular Biology and Immunology", *Curr. Topics in Microb. and Immun.*, 243:123-136, 1999.

Jayasena, S.D., "Aptamers: An Emerging Class of Molecules That Rival Antibodies in Diagnostics", *Clin. Chem.*, 34:1628-1650, 1999.

Kiel, Johnathan et al., "Diazolumelanin: A Synthetic Electron and Nonradiative Transfer Biopolymer", *Proceedings of the 1989 International Symposium on Charge and Field Effects in Biosystems-2. Held Jun 4-9, 1989 in Richmond, Virginia*, pp. 293-300, M.J. Allen et al., Editors.

Yu and Bruno, "Immunomagnetic-electrochemi-luminescent detection of *Escherichia coli* 0157 and *Salmonella typhimurium* in foods and environmental water samples", *Appl. Environ. Microbiol.*, 62:587-92, 1996.

Bruno & Yu, "Immunomagnetic-electrochemiluminescent detection of *Bacillus anthracis* Spores in Soil Matrices", *Appl. and Environ. Microb.*, 62(9):3474-3476, 1996.

Drolet, D.W. et al., "A high throughput platform for systematic evolution of ligands exponential enrichment (SELEX)", *Comb. Chem. High Throughput Screen.*, Oct. 2(5):271-278, 1999.

Ellington & Szostak, "In vitro selection of RNA molecules that bind specific ligands", *Nature*, 346:818-822, 1990.

Ellington & Szostak, "Selection in vitro of single stranded DNA molecules that fold into specific ligand-binding structures", *Nature*, 355:850-52, 1992.

Kiel, J.L. et al., "Diazoluminomelanin: a synthetic electron and nonradiative transfer biopolymer", In *Charge and Field Effects in Biosystems-2*, J.J. Allen, S.F. Cleary, F.M. Hawkrige, editors; Plenum Press, New York, 1989.

Kiel, J.L. et al., "Diazoluminomelanin: a synthetic luminescent biopolymer", *Free Radic. Res. Commun.*, 8(2):115-21, 1990.

Klug and Famulok, "All you wanted to know about SELEX", *Mol. Biol. Reports*, 20:97-107, 1994.

Kugler et al., "Photoelectron spectroscopy and quantum chemical modeling applied to polymer surfaces and interfaces in light-emitting devices", *Accounts of Chemical Research*, 32:225-234, 1999.

Tuerk, "In vitro evolution of functional nucleic acids: high-affinity RNA ligands of HIV-1 proteins", *Gene* 137:33-39, 1993.

Tuerk, "Using the SELEX combinatorial chemistry process to find high affinity nucleic acid ligands to target molecules", *Meth. Mol. Biol.* 67:219-30, 1997.

Gatto-Menking et al., "Sensitive detection of biotoxoids and bacterial spores using an immunomagnetic electrochemiluminescence sensor", *Biosensors & Bioelectronics*, 10:501-507, 1995.

Hacia et al., "Detection of heterozygous mutations in BRCA1 using high density oligonucleotide arrays and two-colour fluorescence analysis", *Nature Genetics*, 14:441-447, 1996.

Brody, E.N. et al., "The use of Aptamers in large arrays for molecular diagnostics", *Mol. Diagn.*, Dec., 4(4):381-388, 1999.

Lorsch and Szostak, "In vitro selection of nucleic acid sequences that bind small molecules." In: *Combinatorial Libraries: Synthesis Screening and Application Potential* (R. Cortese, ed.), Walter de Gruyter Publishing Co., New York, pp. 69-86, 1996.

Shoemaker et al., "Quantitative phenotypic analysis of yeast deletion mutants using a highly parallel molecular bar-coding strategy", *Nature Genetics*, 14:450-456, 1996.

Tuerk, C. and Gold, L., "Systematic evolution of ligands by exponential enrichment: RNA ligands to bacteriophage T4 DNA Polymerase", *Science*, 249:505-510, 1990.

Yu and Bruno, "Immunomagnetic-electrochemiluminescent detection of *Escheria*

coli O157 and Salmonella typhimurium in Foods and Environmental Water Samples", App. and Environ. Microbiology, 62(2):587-592, 1996.

ART-UNIT: 166

PRIMARY-EXAMINER: Horlick; Kenneth R.

ABSTRACT:

In a recognition complex system, nucleic acid ligands comprising random DNA sequences are operatively coupled to an organic semiconductor and distributed so as to form an array of recognition complexes. When an unknown chemical or biological analyte is applied to the array, the electrical and/or photochemical properties of one or more of the recognition complexes are altered upon binding of the nucleic acid ligand to the analyte. The degree to which the electrical and/or photochemical properties change is a function of the affinity of the nucleic acid ligand sequence for the analyte. The electrical and photochemical changes associated with the array, as a whole, can be used as a unique signature to identify the analyte. In certain embodiments, an iterative process of selection and amplification of nucleic acid ligands that bind to the analyte can be used to generate a new array with greater affinity and specificity for a target analyte, or to produce one or more nucleic acid ligands with high binding affinity for an analyte. The present invention also provides methods for preparing nucleic acid ligands that bind with high affinity to an analyte and using such nucleic acid ligands to neutralize the analyte.

62 Claims, 31 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 15

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Detailed Description Text - DETX:

An example of a nucleic acid ligand comprising nucleoside or nucleotide derivatives and mimics is a "polyether nucleic acid", described in U.S. patent Ser. No. 5,908,845, incorporated herein by reference, wherein one or more nucleobases are linked to chiral carbon atoms in a polyether backbone. Another example of a nucleic acid ligand is a "peptide nucleic acid", also known as a "PNA", "peptide-based nucleic acid mimics" or "PENAMs", described in U.S. patent Ser. Nos. 5,786,461, 5,891,625, 5,773,571, 5,766,855, 5,736,336, 5,719,262, 5,714,331, 5,539,082, and WO 92/20702, each of which is incorporated

herein by reference. A peptide nucleic acid generally comprises at least one nucleobase and at least one nucleobase linker moiety that is not a 5-carbon sugar and/or at least one backbone moiety that is not a phosphate group. Examples of nucleobase linker moieties described for PNAs include aza nitrogen atoms, amido and/or ureido tethers (see for example, U.S. Pat. No. 5,539,082). Examples of backbone moieties described for PNAs include an aminoethylglycine, polyamide, polyethyl, polythioamide, polysulfonamide or polysulfonamide backbone moiety.

Detailed Description Text - DETX:

Peptide nucleic acids generally have enhanced sequence specificity, binding properties, and resistance to enzymatic degradation in comparison to molecules such as DNA and RNA (Egholm et al., Nature 1993, 365, 566; PCT/EP/01219). In addition, U.S. Pat. Nos. 5,766,855, 5,719,262, 5,714,331 and 5,736,336 describe PNAs comprising nucleobases and alkylamine side chains with further improvements in sequence specificity, solubility and binding affinity. These properties promote double or triple helix formation between a target and the PNA.

Claims Text - CLTX:

31. The recognition complex system of claim 28, further comprising a data processing unit, a magnetic electrode and a magnetic filter.